REMARKS

Response to the §112 Rejections of Claims 15-16

In the outstanding Office Action, the Examiner rejected claims 15-16 of the present application under 35 U.S.C. §112, second paragraph as allegedly indefinite. Specifically, the Examiner objected to the recitation by claim 15 (from which claim 16 is depend) of a trench dielectric material that is selected from a TEOS or an oxide on one hand and comprises nitrogen species on the other hand (see Office Action, page 2, second paragraph).

In response, Applicants have hereby amended claim 15 to recite a trench dielectric material that "comprises SiO_2, tetraethylorthosilicate (TEOS), or a high-density plasma oxide with nitrogen species therein." The instant specification described on pages 12-13, paragraphs [0062] and [0063] a plasma nitridation process that subsequently introduces nitrogen species into a trench dielectric material 70 after formation of the trench dielectric material.

Therefore, the trench dielectric material as recited by claims 15-16 of the present invention comprises an oxide material with subsequently introduced nitrogen species therein, which is both clear and definite and in compliance with the requirements of 35 U.S.C. §112, second paragraph.

Response to §103 Rejections of Claims 15-20

In the outstanding Office Action, the Examiner reiterated the previous rejections of claims 15-20 under 35 U.S.C. §103(a) as alleged obvious over previously cited references, i.e., U.S. Patent No. 6,348,394 issued to Mandelman et al. (hereinafter "Mandelman"), U.S. Patent Application Publication No. 2004/0155275 published in the names of Divakaruni et al. (hereinafter "Divakaruni"), and U.S. Patent No. 6,156,620 issued to Puchner et al. (hereinafter "Puchner"). Further, the Examiner cited a new reference, U.S. Patent No. 5,940,717 to Rengarajan et al. (hereinafter "Rengarajan"), and asserted that Rengarajan shows the well-known use of a TEOS dielectric material for filling a trench isolation region in the art (see Office Action, pages 2-3).

However, the Examiner did not respond in any manner to the arguments presented by Applicants in the October 25, 2005 Response regarding the patentably distinctions between the claimed invention of the present application and the previously cited references; nor did the Examiner address how the newly cited reference, i.e., Rengarajan, remedies the deficiencies of the previously cited references.

Applicants therefore traverse the Examiner's rejections based on the same patentable distinctions between the claimed inventions of the present application and the disclosure of the cited references, as previously described in the October 25, 2005 and reiterated hereinafter. Applicants specifically request the Examiner to explain how the previously and newly cited references teach or suggest, if they in fact do teach or suggest, the following elements of Applicants claimed invention, as recited by claims 15-20 of the present application.

I. Patentable Distinctions of Claims 15-16 and 18-20 Over the Cited References

Claim 15, from which claims 16 and 18-19 depend, positively recites "a trench dielectric material... with nitrogen species therein." As mentioned hereinabove, the instant specification describes on pages 12-13, paragraphs [0062] and [0063] a plasma nitridation process that is carried out after the trench 60 has been filled with a trench dielectric material 70. Such plasma nitridation process inevitably introduces nitrogen species into the trench dielectric material 70.

The Puchner reference discloses formation of a nitrogen-containing barrier region 50 or 54 by a nitrogen plasma process, before the trench 30 is filled with a trench filler material 80 (see Puchner, Figures 8 and 13, column 5, lines 49-56 and column 6, lines 38-43). More importantly, Puchner discloses that a silicon oxide layer 70 is formed over the nitrogen-containing barrier region 50, in order to "confine the nitrogen atoms in barrier region 50 from diffusing to other filler materials in trench 30" (see Puchner, column 5, lines 24-26).

Therefore, **the trench filler material 80 disclosed by Puchner does not contain nitrogen species**, in contrast to the recitation of a trench dielectric material with nitrogen species therein by claims 15-16 and 18-20 of the present application.

Mandelman discloses formation of a nitride liner 16 by a low-pressure chemical vapor deposition (LPCVD) process or a rapid thermal chemical vapor deposition (RTCVD) process before formation of a trench oxide filler 17 by a high-density plasma (HDP) chemical vapor deposition process (see Mandelman, Figure 1D, column 3, lines 22-37).

Therefore, **the trench oxide filler 17 disclosed by Mandelman also does not contain nitrogen species** and cannot remedy the deficiency of the Puchner reference.

Divakaruni discloses formation of a nitride liner 50 before formation of a trench top oxide 28 by a high-density plasma (HDP) chemical vapor deposition process (see Divakaruni, Figure 2(b), page 3, paragraph [0040]).

Therefore, like Puchner and Mandelman, **Davakaruni also discloses a trench filler that does not contain nitrogen species**.

The newly cited reference, Rengarajan, discloses formation of a nitride liner 114 or 704 before deposition of the trench oxide fill 702 (see Rengarajan, Figures 6-8, and column 7, lines 21-50).

Therefore, **the trench oxide filler 702 as disclosed by the new reference Rengarajan still does not contain nitrogen species** and cannot remedy the deficiency of the previously cited references, Puchner, Mandelman, and Davakaruni.

In summary, claims 15-16 and 18-20 patentably distinguishes over all the cited references Puchner, Mandelman, Divakaruni, and Rengarajan, by expressly reciting a trench dielectric material with nitrogen species therein.

II. Patentable Distinction of Claim 17 Over the Cited References

Claim 17 of the present application expressly recites a trench isolation region containing a nitrided surface layer that has "a thickness of about 0.1 to about 2.0 nm."

In the Office Action dated March 16, 2005, the Examiner conceded that the Mandelman reference fails to teach the use of very thin nitride layers having thickness between 0.1 to 2.0 nm, but attempted to remedy such a deficiency of Mandelman by citing the Divakaruni reference, which discloses a nitride layer of about 1 nm thick (see the March 16, 2005 Office Action, page 3, first paragraph).

Applicants respectfully disagree with the Examiner's reasoning for combining the Mandelman and Divakaruni references, for the following reasons.

It has been well established it is improper for the Examiner to combine references where the references *teach away* from the combination. In re Grasselli, 218 USPQ 769 (Fed. Cir. 1983). The Examiner cannot "*disregard[ing] disclosures in the references that diverge from and teach away from the invention at hand.*" Panduit Corp. v. Dennison Manufacturing Co., 227 U.S.P.Q. 337 (CAFC 1985).

Mandelman discloses a trench isolation region that contains a nitride liner for trapping charge therein, so as to control array threshold voltage (see Mandelman, column 1, lines 52-59). Specifically, Mandelman teaches that the preferred thickness for the nitride liner is greater than 5.5 nm, that the threshold voltage shift continues to increase with the nitride liner thickness until the nitride liner thickness reaches between 9 nm and 11 nm, and that there is no upper limit for the nitride liner thickness, because there is no deleterious effect for use of thicker nitride liner (see Mandelman, column 4, lines 40-46).

Mandelman shows a strong preference for thick nitride liners (i.e., > 5.5 nm thick), which diverges from and **teaches away** from use of thin nitride liners with thickness ranging between 0.1 nm and 2.0 nm, as expressly recited by claim 17 of the present invention.

In light of the express disclosure of Mandelman away from use of thin nitride liners, a person ordinarily skilled in the art, after reading Mandelman, would **not** have been motivated to incorporate the thin trench top oxide (TTO) nitride liner disclosed by Divakaruni, which is used

in trench capacitor structures (see page 1, paragraph [0003] of Divakaruni), into the trench isolation structure disclosed by Mandelman.

Therefore, Divakaruni cannot be properly combined with the Mandelman reference and thus does not remedy the deficiency of Mandelman.

The Puchner and Rengarajan references are silent on the respective thicknesses of the nitride liners disclosed thereby, and they therefore also fail to remedy the deficiency of Mandelman.

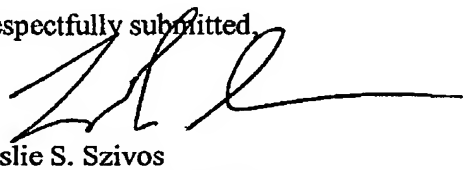
As a result, claim 17 is patentably distinguished over the cited references, by reciting a trench isolation region containing a nitrided surface layer that has a thickness of about 0.1 to about 2.0 nm.

CONCLUSION

Based on the foregoing, claims 15-20 as amended herein are in condition for allowance. Issue of a Notice of Allowance for the application is therefore requested.

If any issues remain outstanding, incident to the formal allowance of the application, the Examiner is requested to contact the undersigned at (516) 742-4343 to discuss same, in order that this application may be allowed and passed to issue at an early date.

Respectfully submitted,



Leslie S. Szivos
Registration No. 39,394

SCULLY, SCOTT, MURPHY & PRESSER, P.C.
400 Garden City Plaza, Suite 300
Garden City, New York 11530
(516) 742-4343
LSS/MY